# Active Noise Cancellation

# Using DSP

# Introduction

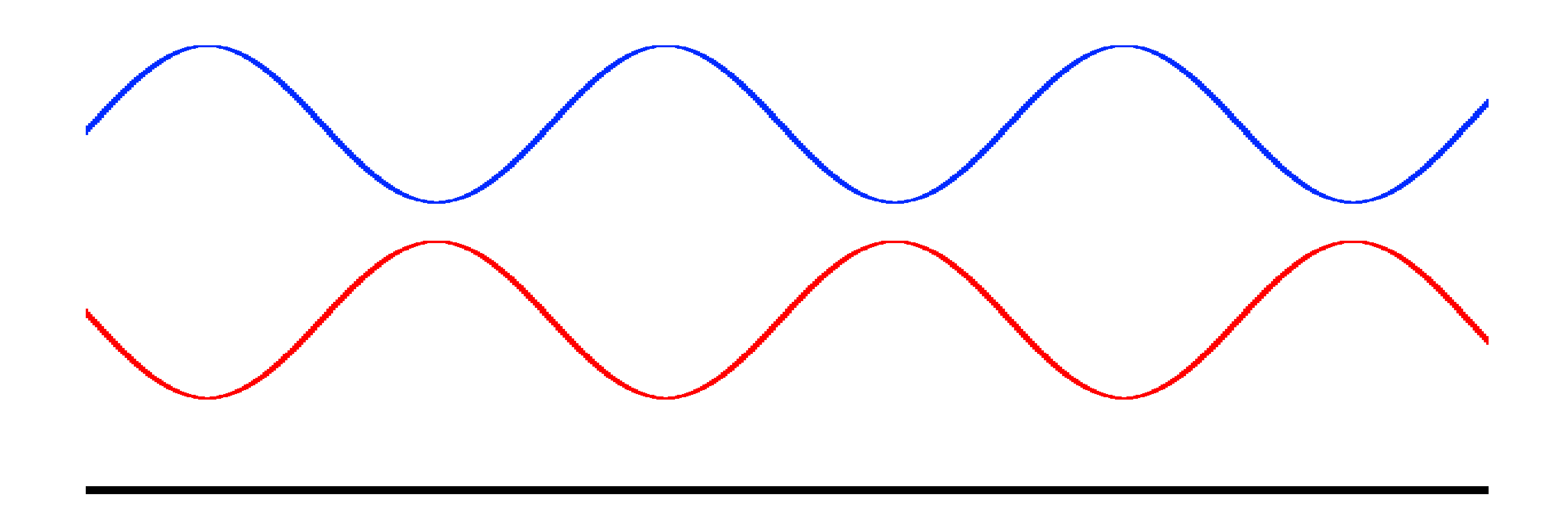
What is Active Noise Cancellation (ANC) ?

- A method to reduce undesired noise by generating more noise.

**WAIT, WHAT ?! How do you cancel noise by generating more noise?**

- The noise generated in fact is called “Anti-Noise” wave, and it is generated through other speakers. These speakers are connected to an electronic system that uses specific signal processing algorithms to identify the noise. Then, it generates the anti-noise wave that fades out the noise.

# Basic Concept



Consider the top wave being the noise wave.
The second wave being the anti-noise wave.
When the original wave (the top wave) is added to the same but inverted wave, they both cancel each other.

# Applications

What are the applications of ANC ?

- Reducing noise generated by airplanes' engines.

- Noise Canceling Headsets.

- Reduce high level noise in working place that can affect hearing ability such as in some factories.

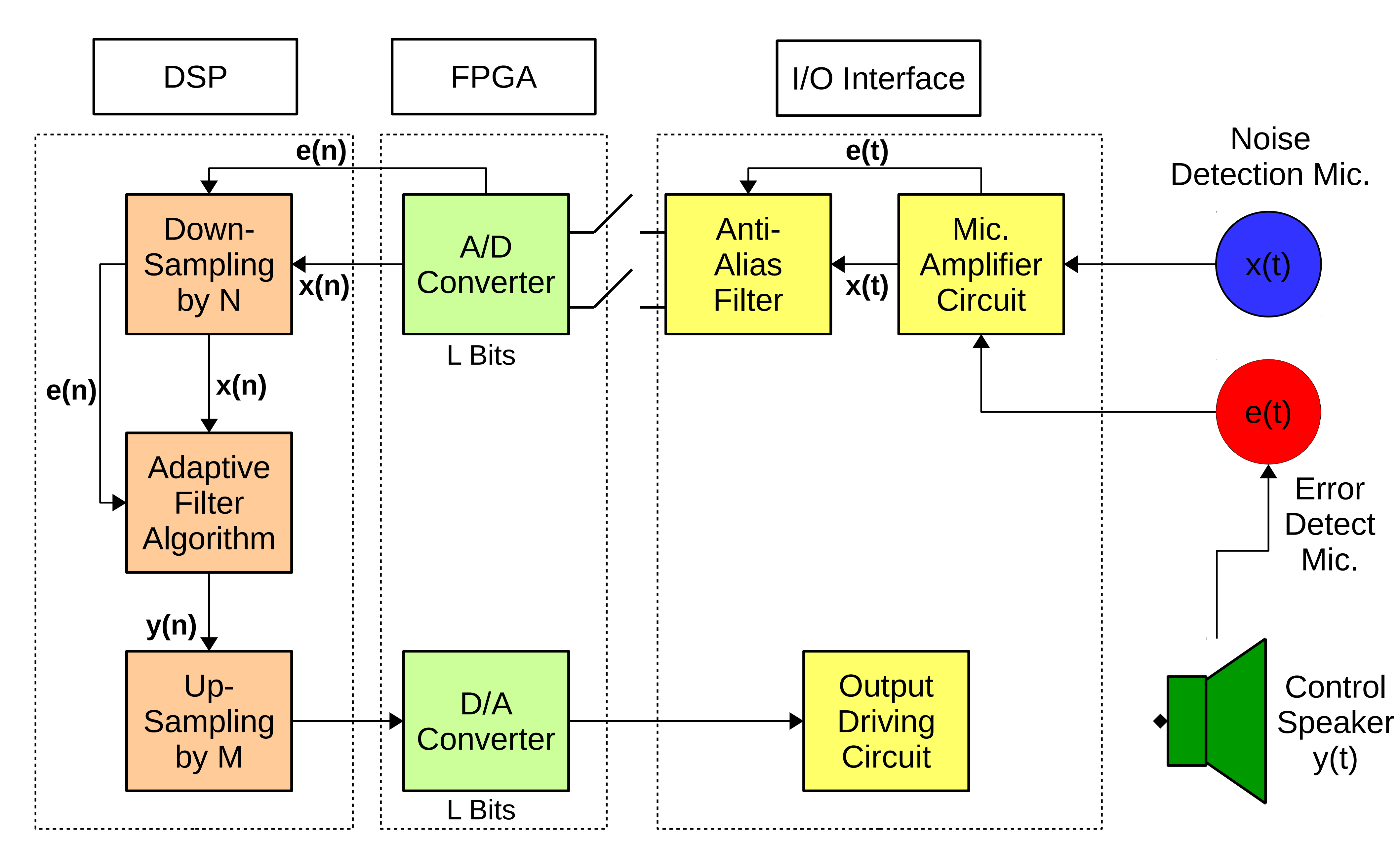
- As a result, it can eliminate vibrations that can cause material wearout.

# Challenges

The challenges are to identify the original signal and generate the inverse without delay in all directions where noises interact and superimpose.

The following block diagram construct shows an ANC system used in a headset

# Block Diagram



# DSP BLOCK

- First, we down-sample to get rid of some data, this allow for low processing time.

- Then an adaptive filter algorithm is applied to adaptively  change the filter coefficients, and it keeps doing that as long as there is error.

**WAIT!! What is the adaptive filter?**

- An adaptive filter is a computational device that iteratively models the relationship between the input and output signals of the filter. An adaptive filter self-adjusts the filter coefficients according to an adaptive algorithm.

- Then, we up-sample to interpolate to get as close as possible to the original signal (Think of it like curve fitting)

# Adaptive Filter Algorithms

Least Mean Square (LMS)

Normalized LMS (NLMS)

Leaky LMS

Normalized Leaky LMS

Sign LMS

- Sign-error LMS algorithm
- Sign-data LMS algorithm
- Sign-sign LMS algorithm

Fast Block LMS

Filtered-x Least Mean Squares (FxLMS) “Widely used”

# Thank You